



UNITED STATES ARMY AVIATION and MISSILE LIFE CYCLE MANAGEMENT COMMAND

The Evolution of Protective Covers for Army Aviation and Missile Systems

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AMCOM Corrosion Program Office



Getting Technology to the War Fighter

Why cover?

- **Protective covers provide protection from:**
 - Environmental effects
 - Particulate intrusion





What are we protecting from?



Environment	Principal Effects	Typical Failure Induced
High Relative Humidity	<ul style="list-style-type: none">• Corrosion• Electrolysis• Moisture absorption	<ul style="list-style-type: none">• Loss of mechanical and electrical strength• Interference with function• Loss of electrical properties• Increased conductivity of insulators
Rain	<ul style="list-style-type: none">• Water absorption and immersion• Erosion• Corrosion	<ul style="list-style-type: none">• Increase in weight; electrical failure• Removes protective coatings• Surface deterioration• Enhances chemical reactions
Wind	<ul style="list-style-type: none">• Force application• Deposition of materials• Heat loss or gain	<ul style="list-style-type: none">• Loss of mechanical strength• Interference with function• Accelerated abrasion and intrusion• Accelerated high/low temperature effects
Sand/Dust	<ul style="list-style-type: none">• Abrasion• Clogging	<ul style="list-style-type: none">• Increased wear• Interference with function• Alteration of electrical properties



The “Old” Way



- Shrink Wrap (Shipping Protection)
- Vinyl Equipment Covers





Shrink Wrap – Total Coverage

- Effective when not compromised and applied under ideal conditions
- Study performed in FY04 found that shrink wrap of current Army aircraft caused more harm than protection
- DA G-4 Issued “Suspension Of Shrink Wrapping Of Army Helicopters” Dec 04 131653Z Message





Vinyl Equipment Covers

- Bulky, heavy and cumbersome to use
- Often not used by soldiers due to difficulty
- Short life due to temperature problems with material
- Provides little to no protection when not used or not used regularly
- Adds burden to the soldier with little benefit





The “New” Way



- Protective covers





New cover requirements



- **Covers must now protect**
 - Environmental effects
 - Particulate intrusion
 - &
 - Contaminate intrusion (Chlorides, etc.)
 - UV degradation
 - Temperature damage
 - Condensation formation (Greenhouse Effect)





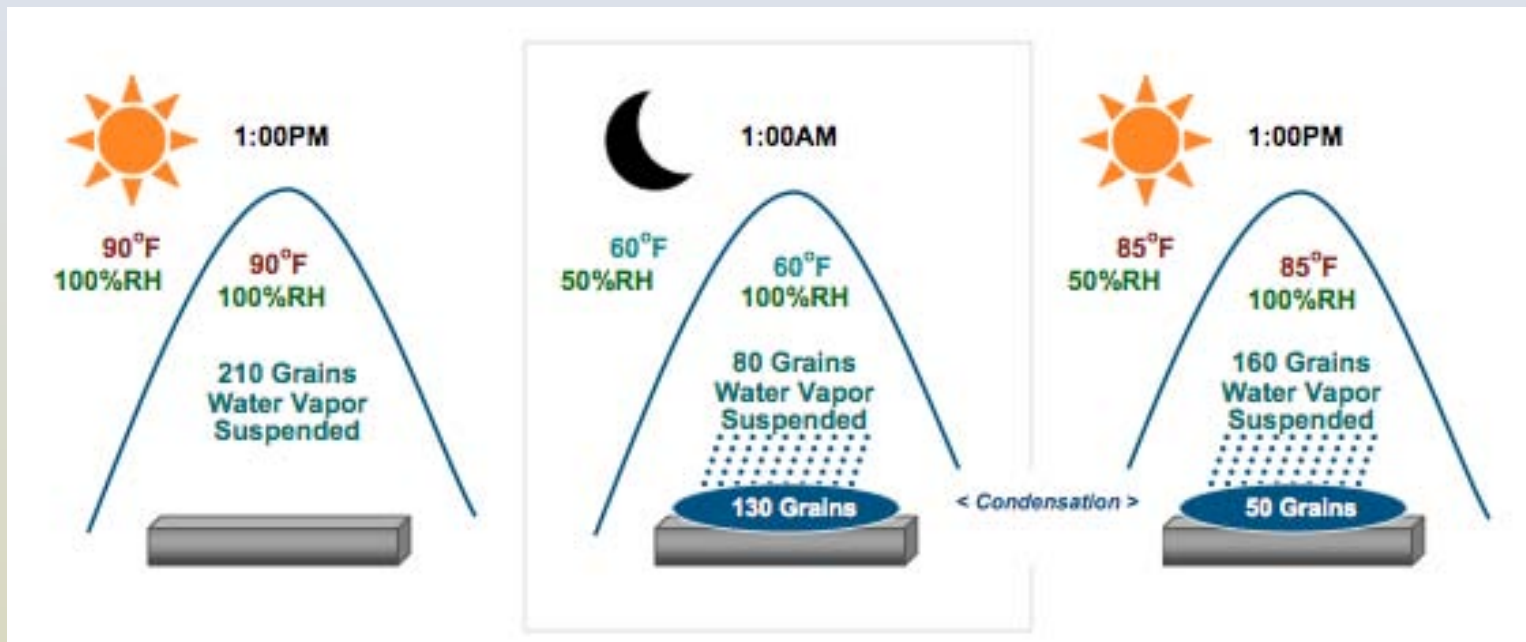
Additional Protection



Environment	Principal Effects	Typical Failure Induced
High Temperature	<ul style="list-style-type: none">• Thermal aging: oxidation, structural change, chemical reaction• Softening, melting and sublimation• Viscosity reduction and evaporation• Physical expansion• Decreased MTBF	<ul style="list-style-type: none">• Thermal aging: oxidation, structural change, chemical reaction• Softening, melting and sublimation• Viscosity reduction and evaporation• Physical expansion• Decreased MTBF
Chemical Intrusion	<ul style="list-style-type: none">• Corrosion, electrolysis	<ul style="list-style-type: none">• Surface deterioration and structural weakening• Alteration of electrical properties• Interference with function• Increased conductivity
UV Radiation	<ul style="list-style-type: none">• Embrittlement• Physiochemical reactions	<ul style="list-style-type: none">• Surface deterioration• Alteration of electrical properties• Discoloration of materials

The “Greenhouse” Effect

- Trapped air within an enclosed space allows condensation to form





Paired Factors



Paired Environment	Principal Effects
Humidity + High Temperature	•High temperature tends to increase the rate of moisture penetration.; the general deterioration effects of humidity are increased by high temperatures
Humidity + UV Radiation	•Humidity intensifies the deteriorating effects of solar radiation on organic materials
Humidity + Chemicals	•High humidity may dilute concentrations and could affect the corrosive action by increasing coverage and thereby increasing conductivity and the rate of corrosion.
Humidity + Particulates	•Particulates have a natural affinity for moisture and this combination increases deterioration
High Temperature + Chemicals	•High temperature increases the rate of corrosion influenced by chemicals (salts and sulfurs)
High Temperature + UV Radiation	•High temperature can increase the breakdown of organic materials by UV radiation
High Temperature + Particulates	•The erosion rate of particulates may be accelerated by high temperature
UV Radiation + Particulates	•Suspected to result in temperature elevation
Chemicals + Particulates	•Particulates and chemicals influence the rate of corrosion and enhance deterioration



Cover technology



- **A “breathable” cover**
 - Allows vapor transfer out while preventing water, contaminants and particulates from intruding
- **A “soft” cover**
 - Will not damage or abrade the surface of the asset
- **A “lightweight and packable” cover**
 - Lightweight and compressible enough to be user friendly
- **A “tough” cover**
 - Can withstand the daily use of a soldier while still performing all other duties listed
 - Resists damage from UV radiation



Aviation Cover applications





Missile Cover Applications





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